CHROMIUM(VI) REDUCTION CHARACTERISTICS OF *Acinetobacter haemolyticus* IMMOBILIZED ON WOOD SHAVINGS

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This page is entirely dedicated my beloved
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ABSTRACT

Hexavalent chromium contamination in the environment is a result of the extensive use of chromate and dichromate in numerous industries including electroplating, stainless-steel production and wood preservation. Cr(VI)-reducing biofilms system in the treatment of Cr(VI)-containing wastewaters has been receiving great attention due to its efficiency and cost effectiveness. In this study, a lab-scale bioreactor consisting of *Acinetobacter haemolyticus* immobilized on wood husk was used to form Cr(VI)-reducing biofilms in packed bed column. The chromium reduction process was carried out at the laboratory–scale bioreactor for 90 days using different batches of electroplating wastewater (EW) containing Cr (VI) ranging from 25-200 mg/L where parameters such as flowrate, nutrient supplementation and initial Cr(VI) concentration in the bioreactor were initially optimized using Response Surface Methodology (RSM). RSM was used to achieve optimum condition for three parameters i.e. flowrate (3-6 mL/min), initial Cr(VI) concentration (40-100 mg/L) and nutrient supplementation (10-20% v/v) for complete reduction of Cr(VI). The attached bacterial cells in the bioreactor were also quantified during the course of Cr(VI) reduction via colony forming unit (CFU/mL) and biofilm development observation in the bioreactor using Field Emission Scanning Electron Microscope (FESEM) analyses. The optimum conditions were determined as flowrate of 3 mL/min, initial Cr(VI) concentration of 100 mg/L and nutrient supplementation of 20%. Under these optimized conditions, the lab-scale bioreactor was able to reduce completely EW at concentration of 100 mg/L in single cycle while two or three cycles were needed for higher Cr(VI) concentrations (110-200 mg/L). The number of *A. haemolyticus* cells in the bioreactor decreases to 10^5 from an initial cell concentration of 10^7 after treatment with 150-200 mg/L Cr(VI). Extracellular Polymeric Substances (EPS) was secreted by the cells in the bioreactor during the course of Cr(VI) reduction as evidenced from FESEM analysis.

ABSTRAK

Pencemaran kromium heksavalen kepada persekitaran adalah disebabkan oleh penggunaan kromat dan dikromat secara meluas dalam pelbagai industri seperti pengelektrogilapan, pengeluaran keluli tahan karat dan pengawetan kayu. Penggunaan sistem biofilem yang menurunkan Cr(VI) di dalam air buangan yang mengandungi Cr(VI) telah menerima perhatian besar disebabkan kecekapan dan kos efektifnya. Dalam kajian ini, bioreaktor berskala makmal yang mengandungi *Acinetobacter haemolyticus* dipegunkan pada habuk kayu digunakan untuk membentuk biofilem yang berupaya menurunkan Cr(VI) dalam turus padat. Proses pengurangan kromium telah dijalankan pada bioreaktor berskala makmal selama 90 hari menggunakan kumpulan air buangan yang berbeza dari proses pengelektrogilapan (EW) yang mengandungi kepekatan Cr(VI) 25-200 mg/L di mana parameter seperti kadar aliran, penambahan nutrien dan kepekatan awal Cr(VI) dalam bioreaktor terlebih dahulu dioptimumkan menggunakan metodologi permukaan resapan (RSM). RSM digunakan bagi mencapai keadaan optimum untuk tiga parameter iaitu kadar aliran (3-6 mL/min), kepekatan awal Cr(VI) (40-100 mg/L) dan penambahan nutrien (10-20% v/v) untuk pengurangan lengkap Cr(VI). Sel bakteria yang dipegunkan di dalam bioreaktor juga dikuantifikasikan semasa pengurangan Cr(VI) melalui koloni membentuk unit (CFU/mL) dan pemerhatian pembangunan biofilem dalam bioreaktor menggunakan analisis FESEM. Keadaan optimum telah dikenalpasti pada kadar aliran 3 mL/min, kepekatan awal Cr(VI) 100 mg/L dan penambahan nutrien 20%. Di bawah keadaan optimum ini, bioreaktor berskala makmal mampu mengurangkan sepenuhnya EW pada kepekatan awal Cr(VI) 100 mg/L dalam kitar tunggal manakala dua atau tiga kitaran diperlukan bagi kepekatan Cr(VI) yang tinggi (110-200 mg/L). Jumlah bakteria *A. haemolyticus* di dalam bioreaktor telah berkurang kepada 10^5 daripada jumlah asal 10^7 selepas rawatan dengan 150-200 mg/L Cr(VI). Luar sel bahan polimerik (EPS) dirembeskan oleh sel bakteria dalam bioreaktor semasa pengurangan Cr(VI) dan dibuktikan melalui analisis FESEM.